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# Identity and autonomy in a human complex system

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## Abstract

The work presented here is centred on the notions of language, of code as well as the interactions that allow to take into account the complex relations between different types of entities, actors, ... corresponding to the embedded cognitive networks . At this level, questions about the identity and the heterogeneity of actors particularly important to the globalisation phenomena can be examined through the negotiation mechanisms and collective decisions. The multiplicity of cognitive shortcuts used, related to the autonomy of actors and institutions or to their interactions, makes it possible to take into account the complexity of human systems.

*Keywords: autonomy, cognitive shortcut, complex mediation, embeddeness, identity.*

The first part of this study will focus on the definition of a complex human system through the idendity concepts, concepts of representation and of belief with reference to the works of Orléan (2002) and Callon (Akrich, Callon, Latour 2006)

Thereafter, the notions of embeddedness (Granovetter 1994) and of decoupling (White 2008) will be highlighted from the socio-economic point of view in order to address the questions related to the autonomy of actors, to the architecture of knowledge and to the co-construction of projects.

Finally, the problems of mediation and learning will be addressed, relative to the collective decisions in particular by referring to the notion of cognitive shortcut that will be used to specify the evolution of systems studied.

## 1. The complexity of human systems

From the onset it seems necessary to specify why our approach differs from the standard economic approach; the present approach begins by an analysis from the cognitive point of view of processes of decision related to the different sorts of actors (agents, groups, communities…) whose identity has to be understood in a procedural context based on the interactionist paradigm.

### 1.1 Cognitive approach

Let P the population of n agents found by the indice i (i = 1 ... n) and E the group of states of nature to which the agents refer in order to construct their representations. The identity of these agents is revealed by the codes that they use in order to translate the vision they have of their environment or the goals they pursuit.

By definition and conforming to Orillard (2005) we consider that a code or rather a coding process is a manipulation system of symbols and we note $C_i$ the group of codes used by the agent i, $E_i$ the cognitive space serving as a referential to that agent and $\underline{E_i}$ the set of possible states for i with $\underline{E_i} \subset E_i$.

It is thus possible to take into account the heterogeneity of agents by basing not on the fact that they have different information or rather different knowledge in the sense of Foray (2000) and of Cowan, Jonard, Zimmermann (2003) but by the fact that here they use distinct processes of coding which correspond more to the procedural aspect of behaviours in the sense of Simon (1982) as right from the onset the objects manipulated are themselves

constructed by the groups, as will be the different projects insofar as they are results of the negotiation processes.

This will be applied to the actors of different nature (groups, communities...) whose potential existence and autonomy will be the object of this study, graphs showing relations linking the agents.

Heterogeneity, which is our concern here refers both to identity of agents and to the nature of actors.

It is thus that the set of codes used by a sub-group A of the population P is noted $C_A$ and $E_A$ the collective cognitive space corresponding to the representations the group A has constructed from an autonomisation mechanism that must be studied further, in an effort to show how this type of mechanism is different from those that are usually taken into account at the level of the formation of coalitions in a cooperative game or from the idea of collective belief as Orléan (2002) suggests.

1.2 Procedural rationality and contextualisation

As it has been said above the behaviour of actors refers to procedural rationality in the sense of Simon. Although now it is not more difficult to justify this approach, it is necessary to describe explicitly the mechanisms which govern the behaviours, the emergence of different types of structures, their evolution as well as the use that can be made of these models in order to illustrate the concept of social oligopoly in the sense of Lesourne (1981).

Our standpoint here is to work within the framework of the modelisation of complex systems departing from the idea according to which the population of reference is heterogeneous (Kirman and Zimmerman 2001) and the cognitive capacities of agents as well as the group or communities taken as autonomous actors are limited; which means it must be acknowledged that it is impossible *a priori* to consider that objective representations of the world exist in which negotiations can be envisaged, hence it is necessary to study the contextualised behaviours and mechanisms.

Here we find parallels to accepted hypotheses concerning individual and collective decision making.

Contextualisation is relevant because the actors do not necessarily use the same coding processes to define individual or collective cognitive spaces but because they also use the links that exist between the sets $C_i$ and $C_A$ relative to the members of an autonomous group A - what is new in this research – and as such they use the social autonomisation process.

At this level reference to the notion of collective belief in the sense of Orléan can be made but we will endeavour to make the process underlying the construction of these beliefs more explicit and sideline the classic questions relative to the aggregation concerning social choices since a normative approach is not adopted, so the reasoning process includes co-construction which draws us closer to the models elaborated in the field of multi-agents systems, to this effect it is possible to see the works of Phan (2004).

1.3 Interactionism and overcoding

In a general way it is considered that the agents are a part of different embedded networks in the sense of Granovetter: the corresponding binary relations are based on the fact that the agents know each other and use one or several identical coding processes (or languages) we therefore define the relations $R_k$ and R:

Let i Є P and j Є P:

i $R_k$ j if and only if i and j know each other and use le same coding process $C_k$

In the same way, we posit:

Let i Є P and j Є P:

i R j if and only if i and j know each other and use at least one common coding process

The emergence of groups within the population will therefore be conditioned by the property of generalised connexity, that is to say, the possibility to link the agent i to agent j

passing through the intermediaries that guarantee the « translation » (Akrich, Callon & Latour 2006) of representations that play the role of cognitive mediators.

In especial cases, henceforth classic in the literature can be envisaged according to the emerging networks, for instance, based on the degree of their connectiveness a star network can be found.

The notion of cognitive mediation leads to the notion of overcoding of Sfez (1993) as the manipulation of codes themselves and no longer of symbols. The implementation of overcoding processes makes the co-construction of collective representations and of possible projects related to the autonomy of actors within the population.

At this level two points need to be addressed concerning on the one hand the interpretation that can be made about this model in terms of architecture of knowledge and on the other hand the accounting of strategic aspects relative to the formation of alliances. These points will be seen in parts 2 and 3 while here we begin by underlining from now itself the intermediary position that we adopt between methodological individualism (key hypothesis as far as the standard theory is concerned) and holism. This intermediary position has proven to be fruitful and has made it possible to make major developments in the field of the economics of networks or in more general terms in the study of populations of heterogeneous agents where it is no longer possible to speak of a representative agent.

Henceforth it must be noted that the relations on which the alliances will depend on, allude not only to the fact that the agents know each other but that they have succeeded in constructing a repertoire in part common (as the notion of codebook of Nooteboom 2002) by manipulating in the same way symbols which it must be admitted lead to the codified knowledge in the sense of Foray (2000)

The instating of overcoding procedures such as the ones that have been envisaged above enables us to refer to the works of Callon (Akrich, Callon, Latour 2006) on the issue of the actor network, the fact that the existence of a group within the population is conditioned both by the cognitive autonomy of the members and by the construction of a project to which it is able to identify itself and which has its own existence. Therefore, social oligopoly is modelised as a community of communities just like Cohendet envisaged to do for an organization (Cohendet, Diani 2003).

To further our reflexion on the processes of collective decisions, the use of this type of modelisation of governance, of negotiation, as well as the research of compromise in public politics can be emphasized like in Amin and Cohendet (2004).

It can be clearly seen here that the way to participate in the elaboration of the models by including the social aspects at the cognitive level in order to explain the emergence and the evolution of the networks of actors, enables us to connect with works relative to the notion of social capital (Burt 1995)

## 2. From embeddness and decoupling to autonomy

### 2.1 Cognitive proximity

In a general manner the proximity between the agents can be envisaged from different points of view since the way they communicate is of interest to us, which is to say, in the case of any two agents to compare the codes they use and to search for the potential cognitive intermediaries by basing essentially on the connexity of graphs relative to the utilisation of these different codes. It is possible to show interest in the social oligopoly and its evolution, and to want to measure the existing proximity between the goals of different actors according to the state that they deem realisable in a way that makes it possible to take into account the adjacent strategic aspect.

First we will direct our interest to the cognitive proximity and then the idea of embeddedness of Granovetter will be illustrated in the following manner:

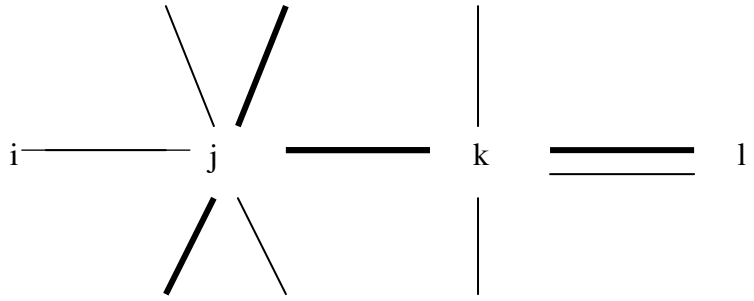


Figure 1: Cognitive networks.

Here the agents are cognitively situated.

This type of representations allows us to propose an illustration for the idea of proximity corresponding to the shortest path relative to the graph of the relation R to go from i to j, an absolutely interesting concept when it is envisaged in a general manner from a binary relation which could be of a spatial, relational, and cognitive nature, to this effect different works will be referred like Bellet, Kirat, Langeron (1998)

But this will allow us to introduce the concept of cognitive shortcut in order to take into account the formation of alliances since the emergence of groups rests on the identification of cognitive shortcuts at two levels, that is to say:

- concerning the utilisation of a higher or lower number of codes used in common and the existence of cognitive intermediaries thus connecting the notion of translation to which we have referred when we introduced the works of Callon.

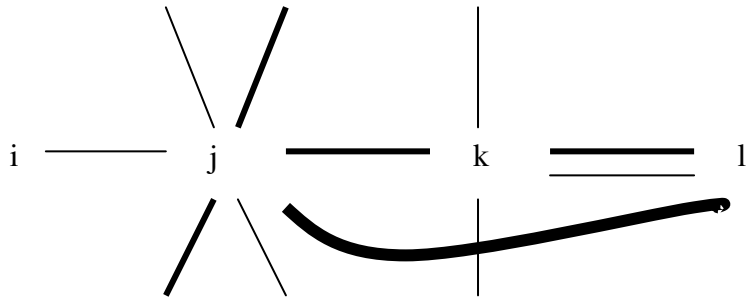


Figure2: Cognitive shortcut.

Therefore the definition hereby:

Definition 1: Function of membership (cf appendix)

-$\forall$ A $\neq \varnothing \subset$ P:

(*) if $\cap_{i \in A}$ $C_i \neq \varnothing$ and A strongly connected through the relation R, then

a (A) = {j / $\exists$ i $\in$ A and j R i et $C_j \cap (\cap_{i \in A} C_i) \neq \varnothing$}

(**) if $\cap_{i \in A} C_{i,} = \varnothing$ and if $\exists$ i $\in$ A as $\forall$ i' $\in$ A : i R i' ( corresponding to a specific form of mediatised connexity) then a (A) = {j / j R i}

(***) if not a (A) = A and A is said "cognitively heterogeneous"

-if A = $\varnothing$ then a (A) = $\varnothing$

- then the relation must be defined enabling the construction of projects as a selection of sub-groups of the states of nature deemed satisfactory by an agent or by a given here noted: $\underline{E}_i \subset E_i$ and $\underline{E}_A \subset E_A$

This step is interesting from different points of view.

It makes it possible to create a link between the construction of projects and the notion of overcoding that is, as it has been said before, about manipulation of codes between themselves according to their cognitive capacities available within the group.

It is thus clear that the reference to the process of overcoding allows to widen the meaning further, in the context that is of interest to us here, that is to say, the modelisation of

collective decision processes, to the idea of translation, and to the concept of actor-network in the sense of Callon because a group said to be autonomous through the project that the members have co-constructed can be identified; the autonomy of a group from a cognitive point of view , as it has been said before, based on the connexity according to the defined relations in 1.3, the strategic autonomy for those groups resting on the existence of a combination of coding processes such as the states to which reference will be made by the group satisfying all the members, in other words, can be written as :

Definition 2

There is a set of coding processes $C_1$, $C_2$,……. $C_k$

as $\forall$ k ,$C_k$ C $U_{i\in A}$ $C_i$ and $\forall$ i, $C_1$( $C_2$(……. ($C_k$ (E))) $\cap$ $\underline{E_i} \neq \varnothing$

$C_k$ (E) corresponding to the representation of E built using the coding process $C_k$

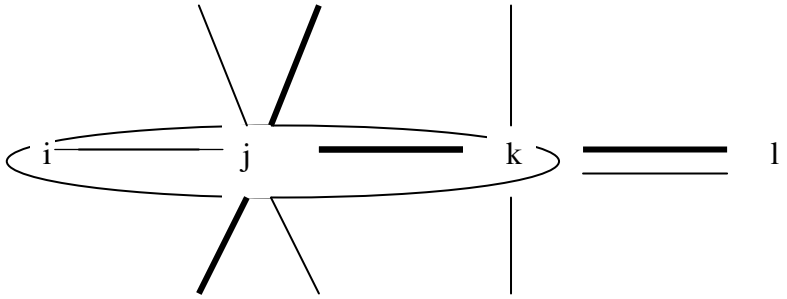


Figure 3: Cognitive and strategic autonomy.

Therefore, it is of great importance to find the shortest combination possible of coding processes, an idea that rests on the second meaning that can be given to the notion of cognitive shortcut the fact that here we refer to the lowest number of intermediaries necessary for the emergence of a project acknowledged to be accepted by all the members of A = {i, j, k}.

2.2 Autonomy and architecture of knowledge

It is now that the importance of making a reference to the pre-topology becomes necessary (cf appendix). The fact that the axiom of growth that conditions the definition of a topology is not necessary, corresponds to the fact that a sub-group of an autonomous group is not necessarily autonomous knowing that a group is cognitively autonomous if:

$\forall$ i Є A and $\forall$ j Є A : i R j

Therefore, for a group to be autonomous from a strategic point of view of course it must be cognitively autonomous, strategic autonomy being able to choose a path to go through the group considered in conformity with definition 2, this path not being necessarily the shortest from the cognitive point of view. It is in this sense that it is indeed possible to take into account the functioning of the negotiation process, a process that sometimes makes the presence of agents necessary, agents that are not compulsory but from the cognitive point of view whose presence leads to the achievement of negotiations.

The most important thing now is that a relation has been clearly established between the notion of decoupling in the sense that the cognitive autonomy and the strategic autonomy rest on the selection of a certain number of coding processes that are manipulated in order to obtain a project emerging from the negotiations that correspond to the idea of White (2008) according to which certain number of relations will be set aside and used to co-construct projects.

In real fact this decoupling can have two levels:

- at the construction level of a codebook common to a certain number of agents knowing that when A $\subset$ P is cognitively autonomous, the set $C_A$ will be defined in the following manner: $C_A \subset U_{i\in A}$ $C_i$
- at the level of the co-construction of the projects
  (cf definition 2 with $C_A$ = {$C_1$, $C_2$,……. $C_k$ }).

Here we illustrate the idea of collective cognition which is compared to the collective belief in sense of Orléan (2002).

### 2.3 Co-construction of projects and social capital

At this level a link with the notions of social capital has to be made and equally of structural holes in the sense of Burt (1995), through the notion of mediation, and with the notion of cognitive complementarity in the sense of Cowan, Jonard and Zimmermann (2003).

As for us we consider that the articulation of coding processes between heterogenous cognitive agents in the way we have defined in the first part corresponds to the interpretation of the different complementarities since:

- the actors construct, from the coding processes, their own representation of the world
- their goal being to participate in the co-construction of the social oligopoly defined as the set of the groups A cognitively and strategically autonomous which are closed (that is to say: a(A) = A, cf appendix)
- and to manage the autonomy of groups to which they belong in the framework of collective negotiations relative to this social oligopoly.

Therefore, it is the interactionist hypothesis that is emphasized of course, but even more so the emergence of groups and their evolution.

## 3. Complex mediation and learning

### 3.1 Different approaches

The classic works on economics of networks are generally based on two criteria that is to say:

- the criterion of stability at the level of the creation of links from the individual point of view,
- the criterion of efficiency related to the global population.

It is in this context that generally the strategies of alliances of the agents and the stability of networks are evaluated (Bala and Goyal 2003).

The economists, sociologists and computer scientists also use the usual techniques of Multi-Agent Systems, and the simulation models too in order to study the emergence and the evolution of structures, it is indeed the case of Phan (2004)

Finally, with regard to the work concerning the stability of coalitions, the line of departure to address the problem of collective decisions and the point of interest being an actor that can be a group of agents - even if all the works quoted refer to the interactionist paradigm -, brings us indeed closer to the reality of the alliance mechanisms from the coding processes and overcoding and enables us to better take into account the procedures of co-construction according to the procedural rationality criterion.

It is thus possible to describe the learning mechanisms that govern the behaviour of different types of actors, agents, groups... by taking for our base the properties of autonomy which we referred to above.

### 3.2 Learning processes and cognitive shortcuts

Let us consider an agent i belonging to time t from a certain number of autonomous groups, autonomous both in the cognitive sense and strategic sense.

Let $C_{i,t}$ the set of codes used by i au temps t. According to the coding processes corresponding to $C_{A,t}$ respectively used by the groups to which he belongs at time t, we posit :

$$C_{i,t+1} = C_{i,t} \cup_{i \in A,t} C_{A,t}$$

Indeed it seems reasonable to think that the members of a group learn to use the codes which enabled the group to construct itself as well as to identify itself and to become autonomous.

This rule of learning makes it possible to study the evolution of structures where we suppose that the agents belonging to the same group despite not knowing each other directly in time t, will be directly linked to time t + 1.

These two principles are justified by the fact that the autonomy of the group itself is constructed from the identity of the agents and their wish to collaborate by looking for as many agents as possible.

Hence, these hypotheses allow us to modelise the relation from agent to agent, agent to group, from group to group by using the above definitions as $C_A$, $E_A$.. and this from the cognitive and strategic point of view as well, thus corresponding to a generalisation of model elaborated in Orillard (2005).

### 3.3 The characteristics of the model

The modelisation done of the construction and the evolution of relations of alliance, in the name of pre-topology (Dallud-Vincent 1998) that abandons the axiom of growth and therefore in a way the transitivity of relations at a given time, whether it is at the cognitive level or at a strategic level, enables us in this way to take into account the private character relative to the construction of alliances.

The notions of membership and closure enables us to translate in an operative manner the idea of autonomy both cognitive (from the definitions of $C_A$, a(A) and defition1) and strategic (from the definitions of $E_A$ et $\underline{E}_A$ and definition 2).

It is therefore of much interest to underline how the search for the greater number of autonomous groups is justified from the point of view of modelisation of a social oligopoly and how the reference to the overcoding processes indeed makes it possible to observe the co-construction of projects.

## Appendix

A 1: Let a set P and an application from **P**(P) to **P**(P) such as :

$a(\varnothing) = \varnothing$

$\forall A, A \subset P \quad a(A) \supset A$

Then the couple (P, a) is called a pre-topological space.

A 2: $\forall A, A \subset P$, A is said a closed set if a(A) = A.

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